Assessment of CHEM 121:

A Cross-Sectional Examination of Student Learning

Fall 2014 – Spring 2018

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Definitions/Abbreviations/Acronyms Used in This Report

AU: is an "Audit" per NSHE Code; for the purposes of this report, audits are not counted.

Average Course Grade: as set forth by NSHE Code (Title 4, Chapter 16, Section 38, Para 5), is a course letter grade of "C".

Bell Curve: A proportionally bell-shaped curve that represents the typical distribution and frequency of a set of random data. It declines gradually bidirectionally from the mean. 50% of a population is above the mean and 50% below the mean.

Cross-Sectional Studies: a fresh sample of subjects is examined/studied each time an experiment is carried out.

Discrimination Index: Discrimination Index (DI) is a Canvas algorithm and, essentially, measures the degree of guessing (the more negative and closer to -1) or expressing knowledge (the more positive and closer to +1) from students.

Ease of Question: EOQ; determined by the number of students answering the question correctly. Canvas' algorithm "concludes" that the more students who respond correctly, the "easier the question". Canvas also refers to this as "difficulty".

Education: cf Glossary, p. 3.

Empowering: cf Glossary, p. 3.

Enabling: cf Glossary, p. 3.

Grading Scale or Grading Policy: is set forth by NSHE Code (Title 4, Chapter 16, Section 38, Para 5); cf also Glossary, p. 4.

Learning: cf Glossary, p. 4.

Longitudinal Studies: the same population of subjects is experimentally examined/studied/followed over time.

NSBE/Q: Not So Big Exam/Quiz. The name was chosen in an attempt to reduce exam anxiety and, hence, increase exam performance.

NSD: Not Statistically Different.

R: is a course repeat, providing the repeated course received a higher grade than the initial course. For the purposes of this report, "R's" were not included in the determination of final course grades' distribution.

SLO: Student Learning Outcomes; every course at WNC is supposed to have SLO's.

Student's 2-Tailed T-Test: Student's T Test compares two averages and tells you if they are different from each other. The t test also tells you how significant the differences are, i.e., it lets you know if those differences could have happened by chance. For differences to be considered statistically significant, the cut-off was at $p < 0.05$ or less.

Studying: application of the mind to the acquisition of knowledge, as by reading, investigation, performing copious amounts of homework, or reflection; may or may not be accomplished in a group setting.

Teaching: cf Glossary, p. 6; teaching comes in many forms, e.g., some use the spoken word, some use the written word; some use both, some use various forms of technology. Teaching methods are protected by academic freedom at WNC [and NSHE Code].

W: is a "withdraw" or "withdrawal" per NSHE Code; for the purposes of this assessment, if counted, a "W" counts as an "F".

WNC-Defined Successful Course/Program Grade: a grade of "C-" is WNC's standard for student success.

WNC-NURS Defined Successful Course/Program Grade: a minimum of a letter grade of a "C" (GPA of 2.0) is required a) for application (and admissions) to WNC's Nursing Program, b) to graduate with an AAS-NURS from WNC and c) to sit for R-NCLEX to earn a license to practice professional nursing. A "C-" in WNC's Nursing Program (or in a required pre- or co-requisite course) is the equivalent of an "F".

Brief Assessment Summary

Introduction: Assessment tools measured student learning/retention in CHEM 121.

> NOTE: When the statement "*CHEM 121 was assessed* …" is used, below, that statement is defined as meaning "when CHEM 121 students were assessed …".

Methods: CHEM 121 was assessed by pre-/post-testing using a self-made assessment tool across the 16-week semester from Spring 2017 through Spring 2018.

Results: CHEM 121 results demonstrated increases in performance across the board ($p <<< 0.001$) by approximately 77%.

Methods: CHEM 121 was assessed vis-à-vis SLO's specifically in NSBE/Q 5, Questions 15, 30, 45 and 60, Spring 2017-Spring 2018, inclusive, using data from Canvas.

Results: Question 15 appeared to show a gain of knowledge by both ease of question and discrimination index (DI) across the semesters; Question 30 showed an assortment of question ease and DI; Question 45 showed increasing question difficulty by semester, as well as no real effect on DI; Question 60 also showed diversity of results: in both Springs, the question was difficult, yet in the Fall, it was easy, albeit more guessing occurred.

Methods: CHEM 121 was assessed vis-à-vis NSBE/Q 5, *in toto*, Fall 2016 through Spring 2018, inclusive, using data from Canvas.

Results: Fall 2016 v Fall 2017 results were NSD; Spring 2017 v Spring 2018 results were NSD; Fall 2016 was NSD from the average, as was Spring 2017. Fall 2017 was above the average ($p << 0.001$), while Spring 2018 was below the average ($p < 0.05$). In Fall 2016, this exam was given twice: once before and once after Thanksgiving break. The scores were NSD against each other and *versus* the average score.

Methods: CHEM 121 was assessed vis-à-vis NSBE/Q 6, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas.

Results: No results were statistically different from the average scores of each class.

Methods: CHEM 121 was assessed vis-à-vis NSBE/Q 7, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas.

Results: Against the average, Spring 2017 and Fall 2017 were lower ($p < 0.05$); Spring 2018 against the average was elevated ($p < 0.001$). Spring 2017 vs Spring 2018 were different ($p < 0.005$).

Methods: CHEM 121 was assessed vis-à-vis NSBE/Q 8, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas. The construct of this experiment was to see if students' exam outcome/results would be impacted by any of three pedagogies: "flip only", "lectures by Dr. Carman", or "lectures by students".

Results: There were no differences of a statistical nature between the three pedagogies on student performance.

Methods: CHEM 121 was assessed using a signature assignment for lab from Spring 2017 through Spring 2018 – these semesters were assessed thus as they represent the first times the signature assignment was primarily entered into and scored by Canvas.

Results: Against the average, only Spring 2017 was different from (less than) the average ($p < 0.05$); all others were NSD.

Methods: CHEM 121 was assessed using a lab theoretical examination using Canvas from Spring 2017 through Spring 2018.

Results: Against the average, all scores were NSD.

Methods: Chem 121 was assessed by examining final course grades from Fall 2014 through Spring 2018. Grades were examined with and without the presence of "F's", by histogram and bell curve.

Results: Both results fit a second-degree polynomial curve remarkably well ($R^2 = 0.98$). In order of Mean, Median, Mode, % ≥ C and % ≥ C-, counting "F's": 1.752 (C-), 2.0 (C), 0.0 (F), 54.76% and 58.33%. When "F's" aren't included (in the same order), the grades are 2.374 (C+), 2.35 (C+), 2.0 (C), 74.19% and 70.03%.

Conclusion: Remove CHEM 121 as a pre-req for BIOL 223 and BIOL 251 per NSBE/Q 8 results. In addition, the Bio-organic CHEM and Cell Biology sections offered in this course by this faculty member simply do NOT support BIOL 223, 224 or 251 adequately like BIOL 190/L does.

Conclusion: Students are not studying as they "should be", e.g., NSBE/Q 5-8 performances.

Conclusion: Per assessment tool and NSBE/Q's, students appear to be selectively learning and they're showing some growth. There's a lot of room for improvement, however.

Conclusion: Students still find CHEM more challenging than BIOL, by one letter grade reduction.

General Conclusion: Scheduling and planning for 30-32 students to use computer labs for secured exams in CED requires great effort and finagling: there are no computer labs at WNC that are singularly large enough to hold a section of 30-32 students. In order to accommodate that many students, along with proper exam security, the proctor (author of this report) is required to walk across non-ADA approved, fatiguing linoleum/concrete surfaces between two computer labs.

If the new BIOL lab remodel is approved and granted by Pennington, perhaps the next remodel to be considered might be to knock the wall out from between CED 331C and 331D to create a computer lab that will handle 44 students at once in one locale. Alternatively, perhaps the rooms could be re-constructed to generate a computer lab that caps at 32 students and another that caps at 12 students (similar to CED 331A's cap of 15, I believe).

Introduction

Assessment at the course, program or institutional level, has become a necessary evil in higher education, today [4]. The gamut of assessment tool design runs from absolute minimum to nationally-accepted exams. While there are national exams for a variety of professions, e.g., medicine, nursing, law, auto mechanic and welding, and for a variety of courses, e.g., American Chemistry Society exams and Human Anatomy and Physiology Society national exam, there's really no "one size fits all" tool, nor a lot of guidance "out there" regarding assessment tools, excepting non-hard science fields.

Nursing has consistently been an exception and a leader in the assessing of their students inasmuch as they have legislative/administrative (NRS/NAC 632 in Nevada) and accreditation requirements that can make or break their programs … and their students.

"Hard, biophysical types of sciences" have attempted to get a handle on student learning and engagement. Carl Wieman [1] has been examining short-term student learning assessment for a number of years. While Wieman's had some success, there's been no long-term follow-up on demonstrating exactly what the students have retained over a longer period of time than one semester, unlike what the R-NCLEX (or USMLE or MCAT), for example, determines.

The traditional 16-week semester-long course makes for long term assessment difficulties; hence, at least in this author's opinion, have been considerably challenging. Accelerating two (2) courses helped in data acquisition that is of more substantial (long term) merit. Accelerating four (4) courses (i.e., completing 2 years' worth of courses in one year), however, has been quite powerful, albeit sometimes painful in terms of meeting administrative ideals for a "one size fits all" assessment for data acquisition, reporting and implementation. That acceleration model has not been attempted with CHEM 121 thus far.

At present, each course at WNC is supposed to have a set of agreed-upon "student learning outcomes" and NSHE-constituted content. This author's courses are no different. If assessment of these SLO's is being completed in an active manner by all participants, students will also participate in the idea of it. Assessment has the potential be a powerful tool to explore issues with student learning and interest [5]. This is not unlike the revolution that is taking place at the University of Southern California (USC) [2, 3], where "popularity contests", AKA student evaluations, are being replaced with tools that include the gathering of student involvement and engagement data in their learning activities. In addition, USC is beginning to shift over to faculty peer evaluations which are similar to the PEG process at WNC.

This report, while avoiding direct statements regarding SLO's, assessed those SLO's using comprehensive embedded assessment tools. That said, the assessment focus lies on and with the student: the one who has the responsibility for internalizing a body of knowledge and being able to demonstrate, synthesize and apply that internalization.

Assessment must also be a process with outcomes that have evidence-based value and that can be reported upon and implemented in a complete manner (would we, as academic faculty accept incomplete work from our students?). Assessment-based projects that span over a complete semester or year tend to get lost over summer when academic faculty are off recovering from the previous year's activities and re-charging for the onslaught of the upcoming new academic year.

In this report, the CHEM 121 assessment is particularly emphasized with the "flipped classroom" pedagogy at WNC-Carson Campus.

Methods

CHEM 121 lecture on the WNC-Carson City campus was presented to students as a "flipped class" for a number of years. After changing the pre-requisite for BIOL 223 and 251 from "only CHEM 121" to "CHEM 121 or BIOL 190/L", students were more successful. This was evidenced by previous assessments that gauged learning and demonstration of CHEM 121 concepts. At that time, the majority of students were "pushed" into CHEM 121 as the only pre-requisite for the pre-Nursing BIOL courses.

The "flipped class" was structured as follows: Every lecture for CHEM 121 has been linked to Dr. Carman's website. They were in block format and written as text chapters at the high school 9th grade level, on average [cf also 6, 7; links to Assessment Conference Presentations at TMCC and UNR regarding both MATH and READing assessments in BIOL/CHEM]. Flipped classes are being recognized more and more [9; Lieberman, M.: **Inside Higher Ed**: *Educators contemplate students' awareness of flipped classroom*

format; 8 August 2018 (truncated hyperlink)]. Ironically, "flipped classroom", the term, is growing negative connotations with students. One faulty member [Ibid] has suggested the term "inverted learning". This author doesn't care for that "jargon", either, although almost **any term** will end up being jargon! This author prefers "**student focused learning**" – still jargon, yet new jargon!

Students are/were expected to read and learn the material, complete daily worksheets that were entered into Canvas for scoring/grading, AND come prepared to class to demonstrate their work to their peers using chalkboards, white boards or document cameras.

Approximately every two (2) weeks, students were examined using Canvas-based exams (NSBE/Q's). These exams eventually formed the basis, along with an overall assessment tool, for assessment in CHEM 121. Exams were in multiple choice, true-false, matching and fill-in-the-blank formats. Calculations were required for success during exams. All exams were proctored by Dr. Carman in the computer lab.

Statistical analyses for significance were determined by Student's Two-Tailed T Test for Variance.

An assessment tool was designed by this author for pre-testing and post-testing students in CHEM 121. The pre-test assessment was given the first day of class in the computer lab at WNC, utilizing the Canvas platform. The post-test assessment was administered again on the last day of class in the computer lab at WNC, utilizing the Canvas platform.

Reviews of the last four Canvas-based NSBE/Q's for the course were part of the assessment, as well.

The utilization of a laboratory-based signature assignment, as well as a lab theoretical exam, were part of the overall assessment. Both utilized the Canvas platform.

Results

All results are presented in graphic format in the Appendices at the end of this report in support of the following statements. All data has been accumulated from either Canvas or myWNC.

CHEM 121 students demonstrated increases in performance across the board ($p <<< 0.001$) by approximately 77%, Appendix 5, **Figure 8**, on the pre-/post-testing assessment tool.

CHEM 121 was assessed specifically in NSBE/Q 5, Questions 15, 30, 45 and 60, Spring 2017-Spring 2018, inclusive, using data from Canvas. Question 15 appeared to show a gain of knowledge by both ease of question and discrimination index (DI) across the semesters; Question 30 showed a mixture of question ease and DI; Question 45 showed increasing question difficulty by semester, as well as no real effect on DI; Question 60 also showed a mixed bag of results: in both Springs, the question was difficult, yet in the Fall, it was easy, albeit more guessing occurred, Appendices 1 and 2, **Figures 1-5**.

CHEM 121 was assessed vis-à-vis NSBE/Q 6, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas. No results were statistically different from the average scores of each class Appendix 3, **Figure 6**.

CHEM 121 was assessed vis-à-vis NSBE/Q 7, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas. Against the average, Spring 2017 and Fall 2017 were lower ($p < 0.05$); Spring 2018 against the average was elevated ($p < 0.001$). Spring 2017 vs Spring 2018 were different ($p < 0.005$). Appendix 3, **Figure 6**.

CHEM 121 was assessed vis-à-vis NSBE/Q 8, *in toto*, Spring 2017 through Spring 2018, inclusive, using data from Canvas. The construct of this experiment was to see if students' exam outcome/results would be impacted by any of three pedagogies: "flip only", "lectures by Dr. Carman", or "lectures by students". There were no differences of a statistical nature between the three pedagogies on student performance, Appendix 4, **Figure** 7.

CHEM 121 was assessed using a signature assignment for lab from Spring 2017 through Spring 2018 – these semesters were assessed thus as they represent the first times the signature assignment was primarily entered into and scored by Canvas. Against the average, only Spring 2017 was different from (less than) the average ($p < 0.05$); all others were NSD, Appendix 6, **Figure 9**.

CHEM 121 was assessed using a lab theoretical examination using Canvas from Spring 2017 through Spring 2018. Against the average, all scores were NSD, Appendix 6, **Figure 9**.

Chem 121 was assessed by examining final course grades from Fall 2014 through Spring 2018. Grades were examined with and without the presence of "F's", by histogram and bell curve. Both results fit a second degree polynomial curve remarkably well ($R^2 = 0.98$). In order of Mean, Median, Mode, % ≥ C and % ≥ C-, counting "F's": 1.752 (C-), 2.0 (C), 0.0 (F), 54.76% and 58.33%. When "F's" aren't included (in the same order), the grades are 2.374 (C+), 2.35 (C+), 2.0 (C), 74.19% and 70.03%. Appendix 7, **Figures 10 and 11**.

Discussion/Observations/Conclusions

Recently, this author became aware of a multitude of issues regarding student pre-requisite preparation in BIOL. This "issue" has ramifications far more reaching than just in BIOL. CHEM can be viewed as a linked issue, as well.

Item 1: "*… grades in these classes are part of the basis for admittance to the nursing program, students are extra sensitive to perceptions of inequity …*"

It's incumbent upon folks taking complaints from students to consider the issues, and thought processes occurring, at USC as previously cited. This author heard similar complaints about the lack of preparation in pre-req MATH coursework from students in his own courses, as well as the same complaints in more advanced CHEM courses.

Readers need to review Dr. Carman's website carefully in addition to reviewing MATH material for CHEM 121. This content is linked conspicuously to his CHEM 121 course content pop-down menus. It's up to the student to go over that material, regardless of who their MATH faculty member was. And … the MATH concepts covered in the MATH Primer are high school MATH concepts … at least as they were taught in the 1970's.

This author still believes that MATH 181 ought to be the pre-req for CHEM 121; and that MATH 126, 127 and 128 (high school MATH courses) ought to be relegated to the remedial, rendering them non-degree-able. MATH faculty want to block an AS in NURS because NURS won't require MATH 181. Do we really want to go down this slippery slope of academic or administrative faculty in one field of study, interjecting their input on fields outside their areas of expertise, i.e., potentially in violation of a faculties' academic freedom?, or might it be more healthy for departmental faculty to determine intra-departmental "inequity" and resolve it?

Finally, grades and inequity are oxymorons. Grades, contrary to most students' beliefs, don't just materialize out of thin air. In order to earn a grade in a course, a student must learn the material and demonstrate that learning, regardless of the inequity. Failing those actions demonstrates clear academic immaturity, much less adequate academic preparation.

This author is very familiar with the complaints that emanate from students … cf also articles regarding USC [2, 3]. Simply having and/or stating a complaint gives no credence or validity to repeating it (nor is it a blanket monopoly on complaints): that destroys institutional collegiality and propagates adversity, i.e., Klemmerer and Associates, 1999 or 2000, mandatory 3-day WNC "be happy in your work" seminar: the 3-R's …

Assessment Tool History

In the late 1990's, this author began utilizing the American Chemical Society's (ACS) standardized exams to determine how CHEM students were performing against their peers nationwide (the author took every ACS exam there was in his undergraduate major's courses, as well as in graduate school). There was some inter-faculty resistance for a number of years about using the exams.

Eventually, both Drs. Tattersall and Evett began using the exams. It was clear from the combined results that the three of us were teaching identical students. Eventually, the ACS adopted a new GenChem 1 exam. For whatever reasons, students had a devil of a time with it and the three faculty opted to develop an intradepartmental assessment tool.

This intradepartmental tool was developed in January 2017, rapidly reviewed over email before classes began and implemented in the author's course as a road test. It was adopted by Drs. Tattersall and Evett the following semester.

After one or two semesters of general use, cohesiveness began to dissipate and the three faculty opted to go their own pathways regarding CHEM 121 assessment. Two of the issues that both the Douglas and the Fallon receiving sites experienced included embedded graphics in Canvas (these were really ISP issues and due to non-awareness of browsers' ability to magnify). The author continues to use the locally-developed tool, excepting the use of other faculty members' content, of course.

As a sort of side note: during the e-review and e-development of the assessment tool, it was pointed out that the homegrown assessment tool more closely fit the SLO's for CHEM 121 than did then ACS exam.

NSBE/Q #5 (Questions 15, 30, 45 and 60) was chosen inasmuch as it's the first exam that covers all the material suggested in the SLO's for the course. Every 15th question was chosen at random for an easily remembered interval. Question 15 was exciting to review: it looked as if changes made to CHEM 121 were working. Questions 30 and 45, however, were drilled into students' heads – it's unknown why they presented as they did across the three semesters. It could simply be inter-class variability, not unlike the results of final course grades for 2015-01 and 2015-03, **Figure 10**, top.

While it appears that students in Spring 2018 were creeping up (NSD) in their exam performances in NSBE/Q #'s 6 and 7, there is room for improvement. Fall 2018 ought to be interesting to follow to see what happens.

NSBE/Q #8 is an exam over material to support students who desire to go into NURS, but who prefer to take CHEM 121 over BIOL 190/L. Of interest, students' complaints about the format of the course appear to be a) unfounded, and b) loud, vocal, lashing-out sorts of excuses for poor performance. The great irony is that when students complete CHEM 121 and enter BIOL 223 or 251, they find that they're not prepared for the more advanced BIOL course[s]. There's a student who learned this the hard way and is now a year behind in being able to apply to Nursing School at WNC.

The signature assignment for CHEM 121 is an experiment that I brought from my undergraduate institution. It utilizes every lab skill that students are expected to learn throughout the semester including theoretical applications to experiments and reading comprehension. There is slow improvement over the three semesters studied. In Spring 2018, there were actually students who came in for guidance who were getting the one concept that most had failed to grasp over the years. Note should also be made that, to this author's knowledge, WNC-Carson is the only NSHE institution that possesses and uses a magnetic susceptibility balance in CHEM.

Figure 9, top, illustrates that there is, again, a mixed bag of results regarding the lab theoretical final. The purpose of that exam is to "light a fire" under students to study adequately for the lecture final exam, i.e., the post-test assessment tool. It appears to be successful in that endeavor … now if students would study for the lab theory exam just as diligently as the assessment!

Last, final course grade distribution was examined in an unusual manner: first grades of A-F were examined, Appendix 7, **Figure 10**, **all**. That the final course grades fit a second-degree polynomial "distribution" curve with an R^2 of 0.98 was gratifying. It was also disappointing: the exams aren't that difficult and the author holds office hours to assist students (indeed, holding office hours in the new lab has increased student attendance to office hours, however, more students need to come). Appendix 7, **Figure 11, all**, illustrates the effect that the "F's" had on the final course grades. While students are told that their grades are inextricably linked to their classmates' grades, they appear to not care about that.

Of interest in **Figure 11** is that the distribution and the percent of students with grades at or above a "C" runs virtually neck and neck with that found for BIOL 223/224 in the Accelerated Course Assessment Report. This was not altogether unexpected: way back in the late 1980's, a study was performed on medical students at UN[R]SOM that examined the effect of course name on exam grade (Human Biochem and Human Physiology – endocrine exam was used for the assessment). The results were intriguing: identical lecture topic, different profs, same exam, different course, different exam name and the medical students scored one letter grade lower on the Human Biochem exam, which was verbatim the Human Physiology exam following immediately without a break between the two courses.

It's clear that students aren't "lazy": many hold more than one job, have children, drive 15-75 miles to get to class, have spouses, or health issues. The issue is "priority". Education, **at this stage of their academic development is not a priority** if they don't have a specific goal and the drive to attain that goal, e.g., like the majority of pre-nursing students. They're distracted from optimal learning.

Recommendations

The vast majority of recommendations involve scheduling and appropriate utilization of resources, i.e., academic faculty. That said, there is a population-based (declination) issue in this country that will drop enrollments (Mickey Wade, MS, RN, Judy Cordia's immediate predecessor, predicted this happening, as regards nursing and health care, in general, 20+ years ago), eventually. It's happened before, it'll happen, again.

** The use of computer labs to administer secured assessments during class/lab time necessitate an adjustment in computer lab size. When the faculty member is walking across the open lab to observe an additional room of students, security (i.e., academic integrity) is compromised. If the new BIOL lab remodel is approved and granted by Pennington, perhaps the next remodel to be considered might be to knock the wall out from between CED 331C and 331D to create a computer lab that will handle 44 students at once in one locale. Alternatively, perhaps the rooms could be re-constructed to generate a computer lab that caps at 32 students and another that caps at 12 students (similar to CED 331A's cap of 15, I believe).

** Remove CHEM 121 as a pre-req for BIOL 223 and BIOL 251 per NSBE/Q 8 results. In addition, the Bio-organic CHEM and Cell Biology sections offered in this course by this faculty member simply do NOT support BIOL 223, 224 or 251 adequately, as does BIOL 190/L.

Change. A word that strikes terror into even the staunchest of hearts. Change cannot just come from above: it must also come from below. George C. Marshall was well aware of that and developed the practice of supporting his "boots on the ground" commanders from his desk in Washington, DC. Assessment data at the classroom level can change education in an evidence-based manner that will benefit students and the institution just as well as change coming from above … and, maybe, even better.

** Something else to consider, regarding the completion of assessment projects in such a manner that they aren't "lost" during summer breaks or remain incomplete indefinitely: perhaps one idea is to have the B faculty return a week later in the Fall and stay a week longer in the Spring, i.e., spend a week post-graduation working up assessment projects that are complete and meaningful.

** There are some radical changes that could be considered: 1) remove the opportunity to withdraw from a course [8, NSHE Code, Title 4, Chapter 16, Section 38, Subsection 4] from the end of the 9th week to the end of the 4th week; 2) remove the choice to audit a course [8, Section 24, subsection 2] and/or 3) permit one repeat per course within a fixed period of time [8, Section 24, subsection 2].

** Perhaps less radical, but nevertheless still tantalizing, maybe an accelerated MATH 128 taught in the first 8 weeks of a semester followed immediately by an accelerated CHEM 121 the second 8 weeks of the semester is a solution for some (many??, most??) of the students (the BIOL students did quite well in the accelerated courses: it's possible that MATH/CHEM students could benefit from that approach, as well).

While CHEM 121 students performed well below the College's "targets" per final course grade, **they hit the mark on the assessment tool in terms of "knowledge improvement"**. It's possible that these general education students (with a few exceptions) are simply buying into the recent Reno Gazette-Journal article, *"Nevada Schools Rank Low; Lyon County Outperforms State Averages"*, and will have to learn to let high school go.

If there was any one thing that came out of this specific study, it's that things, from an academic/teaching/learning perspective, while are improving in BIOL, have a looooooooong way to go in CHEM. But … beware of pushing your most loyal employees to the point where they no longer care. Genuine internal PR has suffered since Jim Randolph left this institution …

Appendices

Appendix 1: CHEM 121 Assessment

NSBE/Q 5, Questions 15, 30, 45 and 60

Cross-Sectional Results: GESLO's 1, 4 and 7:

General Education Course Goals/Outcomes/Objectives	Upon successful completion of CHEM 121, General Chemistry I, (defined as a 75% course score or better) learners will be able to (GESLO = General Education Student Learning Outcome; ISLO = Institutional Student Learning Outcome): Describe, identify and balance the six (6) general types of chemical, as well as college freshman level reduction oxidation, reactions (GESLO #1; ISLO #1); Illustrate, explain and/or identify the chemistry and function of aqueous solutions of acids and bases (GESLO #1, #4; ISLO #1, #4, #7); Illustrate, explain and/or identify the role thermochemistry plays in forming molecules in the solid, liquid and gaseous states (GESLO #1, #4; ISLO #1, #4, #7); Illustrate, explain and/or identify the role the periodic table plays in chemistry (GESLO #1, #4, #8; ISLO #1, #4, #7); Draw and/or identify conclusions with basic calculations of and from general chemistry laboratory experiences (GESLO #1, #4; ISLO #1, #4, #7).

Spring 2017, Fall 2017 and Spring 2018 Semesters

Question 15 NSBE/Q #5

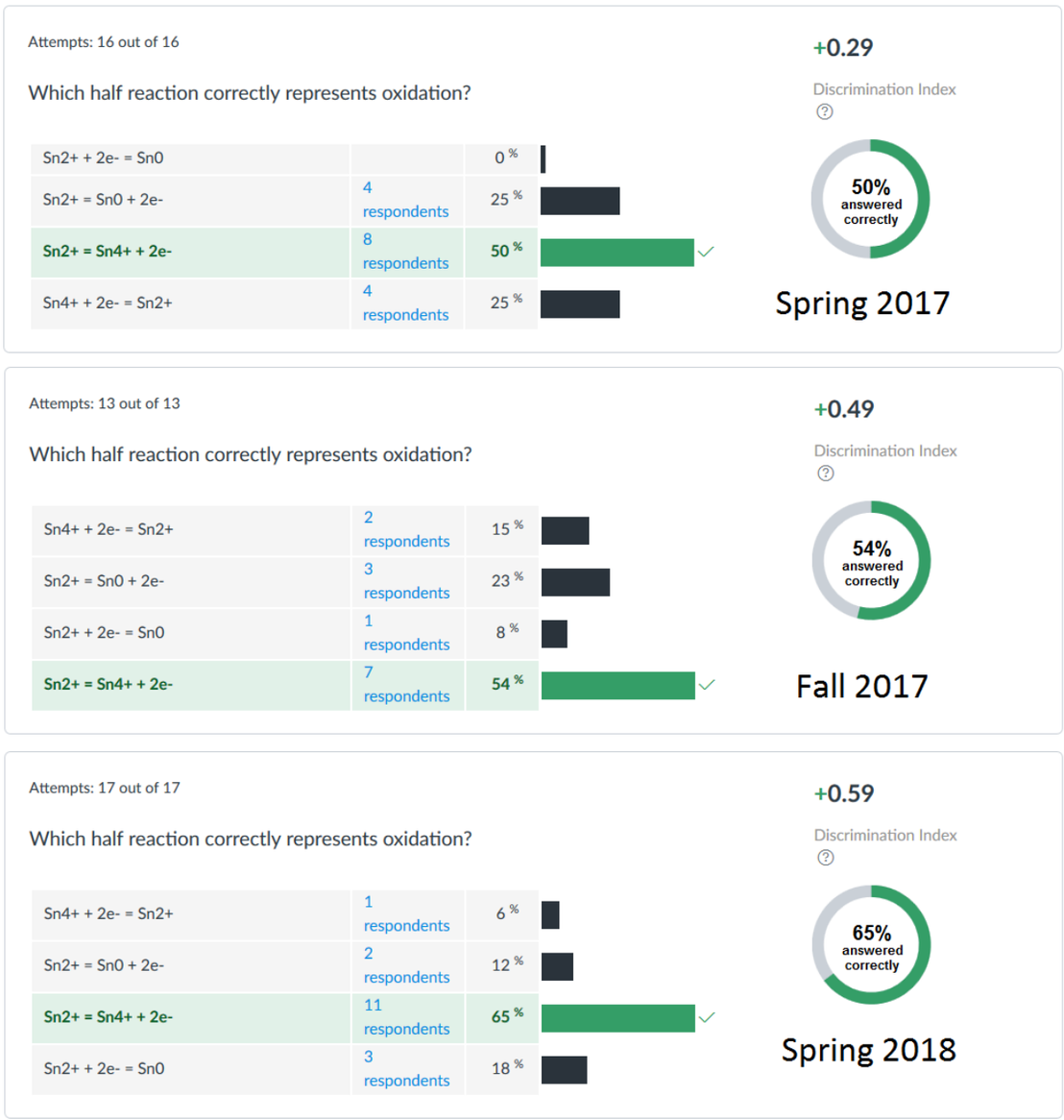


Figure 1: Question 15 from NSBE/Q 5. Discrimination Index is a Canvas algorithm and, essentially, measures the degree of guessing (the more negative and closer to -1) or knowledge (the more positive and closer to +1) from students. Difficulty is another Canvas algorithm that measures level of difficulty by the number of students answering the question correctly.

Question 30 NSBE/Q #5

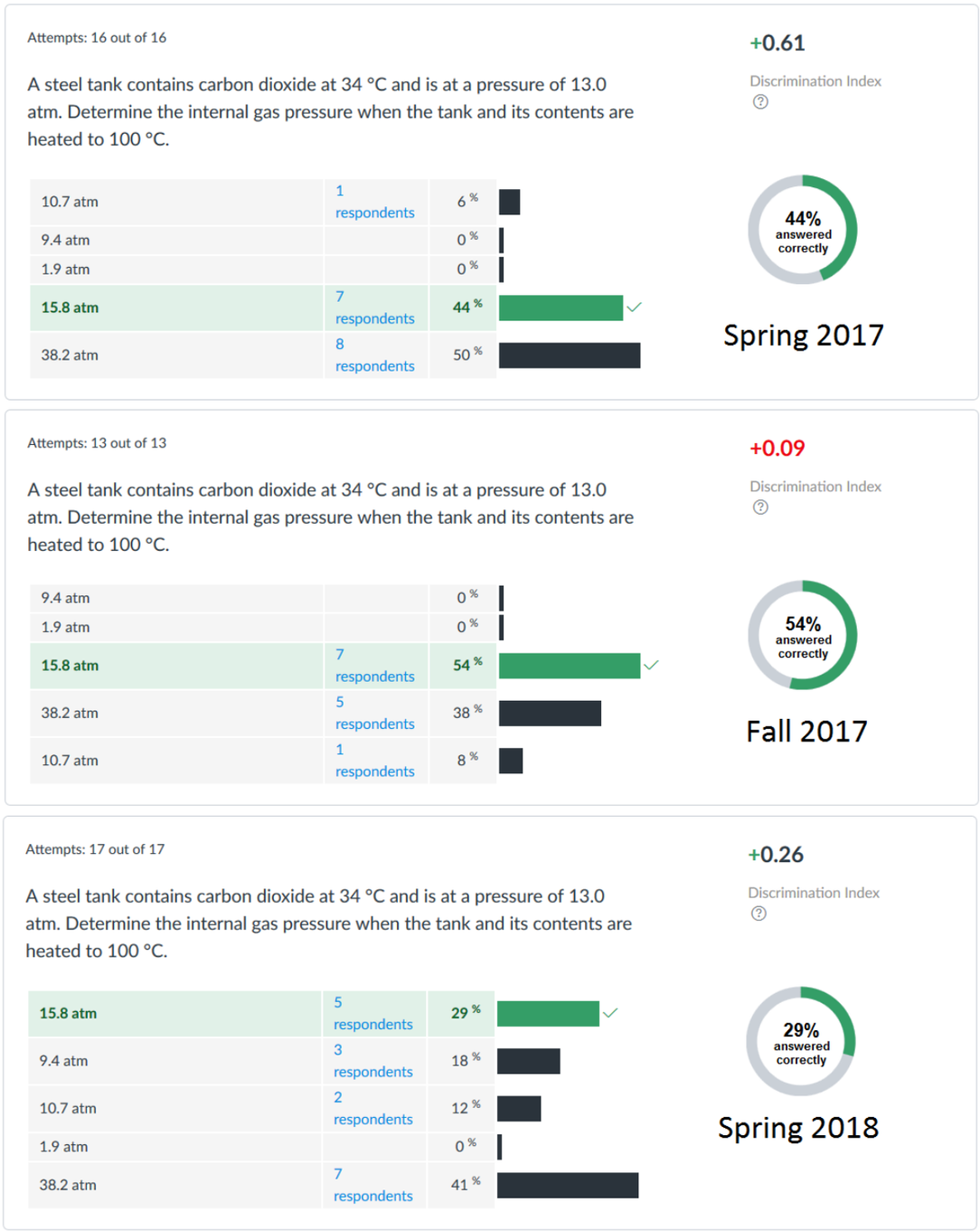
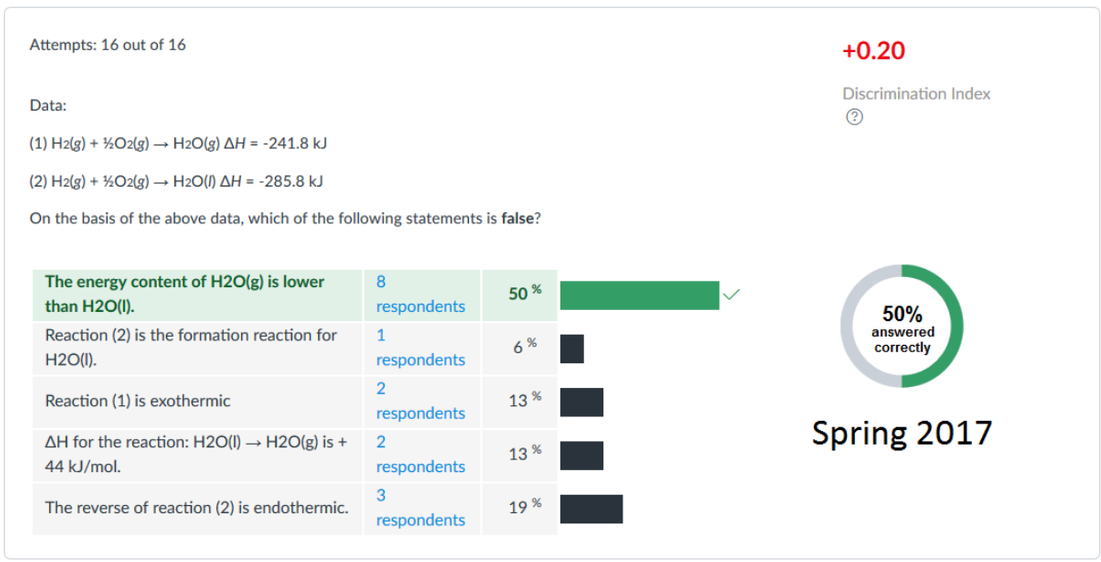
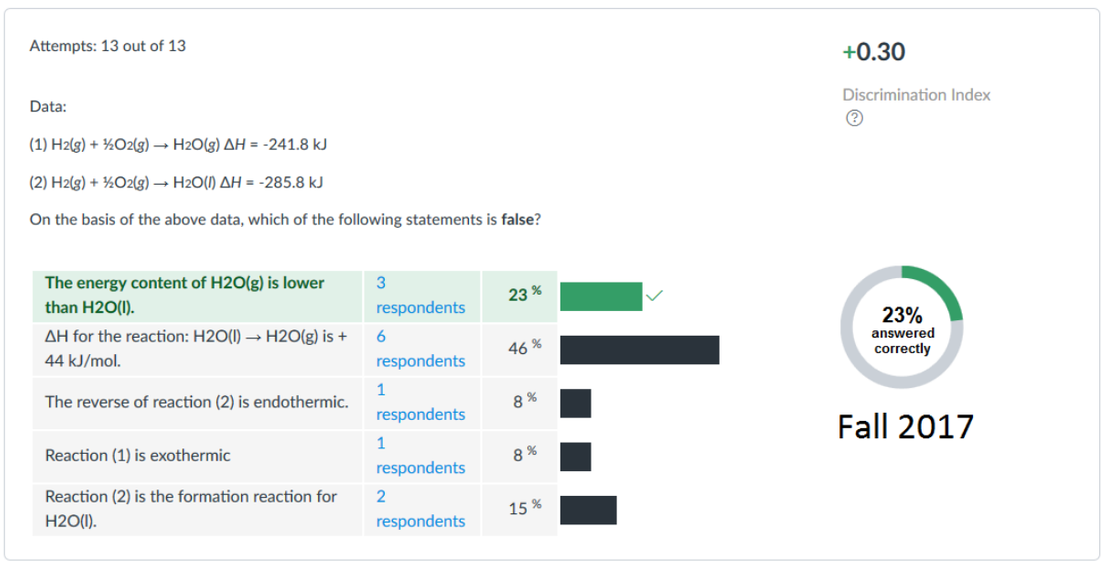


Figure 2: Question 30 from NSBE/Q 5. Discrimination Index is a Canvas algorithm and, essentially, measures the degree of guessing (the more negative and closer to -1) or knowledge (the more positive and closer to +1) from students. Difficulty is another Canvas algorithm that measures level of difficulty by the number of students answering the question correctly.

Question 45 NSBE/Q #5





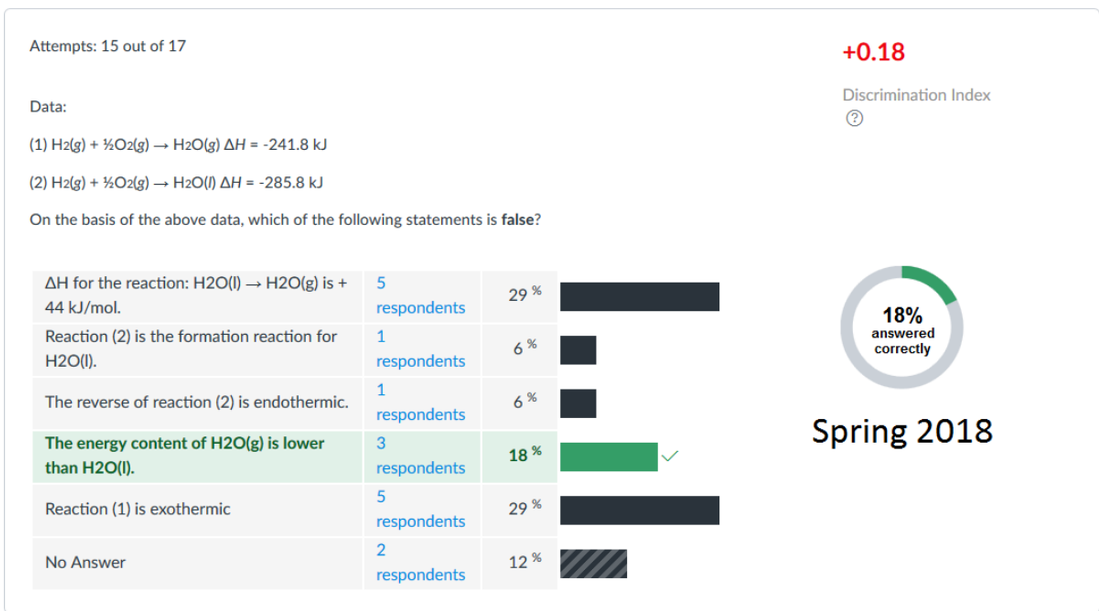


Figure 3: Question 45 from NSBE/Q 5. Discrimination Index is a Canvas algorithm and, essentially, measures the degree of guessing (the more negative and closer to -1) or knowledge (the more positive and closer to +1) from students. Difficulty is another Canvas algorithm that measures level of difficulty relative to the number of students answering the question correctly.

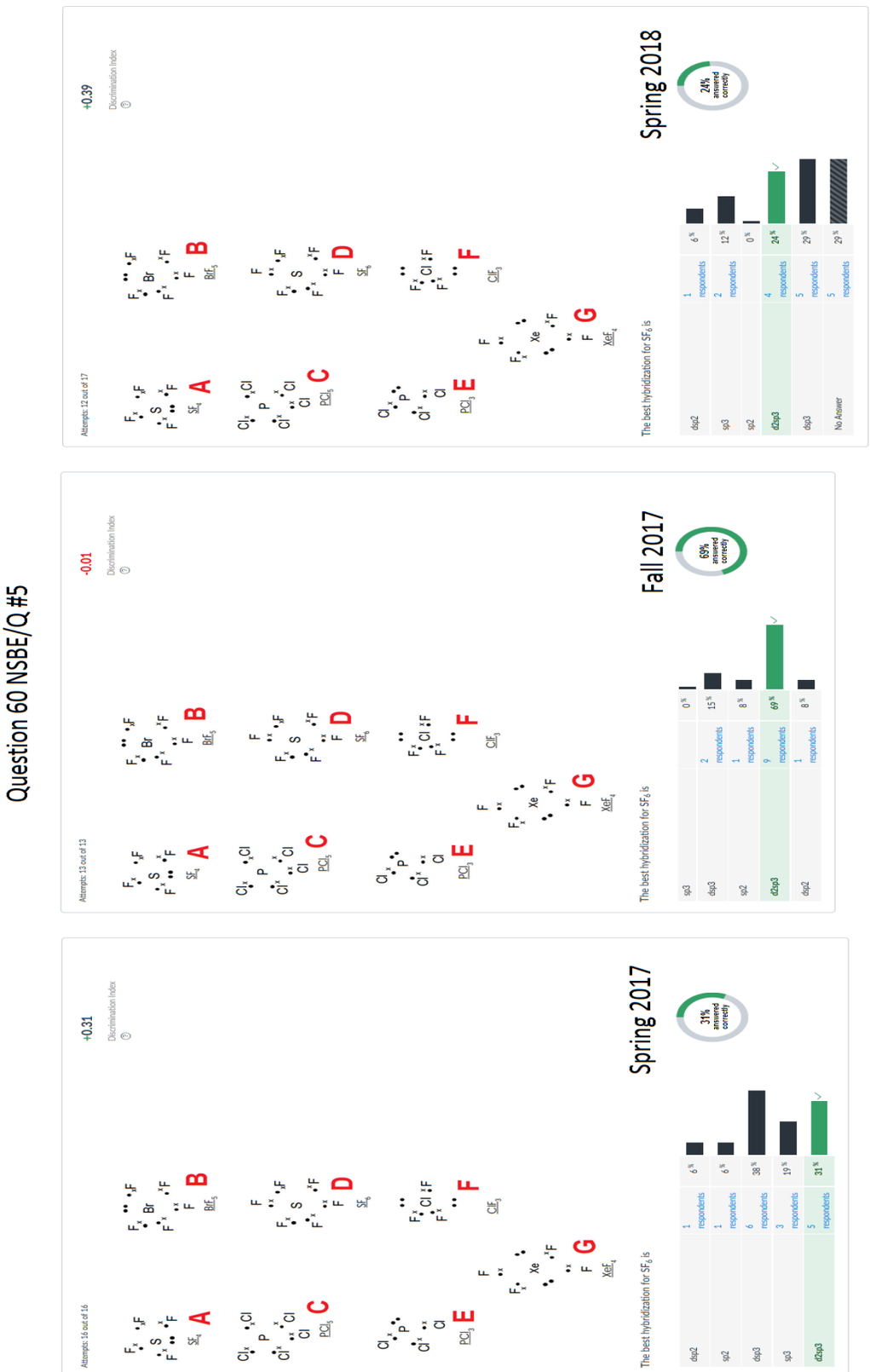


Figure 4: Question 60 from NSBE/Q 5. Discrimination Index is a Canvas algorithm and, essentially, measures the degree of guessing (the more negative and closer to -1) or knowledge (the more positive and closer to +1) from students. Difficulty is another Canvas algorithm that measures level of difficulty relative to the number of students answering the question correctly.

Appendix 2: CHEM 121 Assessment

NSBE/Q 5, in toto

Cross-Sectional Population/Enrollment Results

Fall ‘16 – Spring ‘18

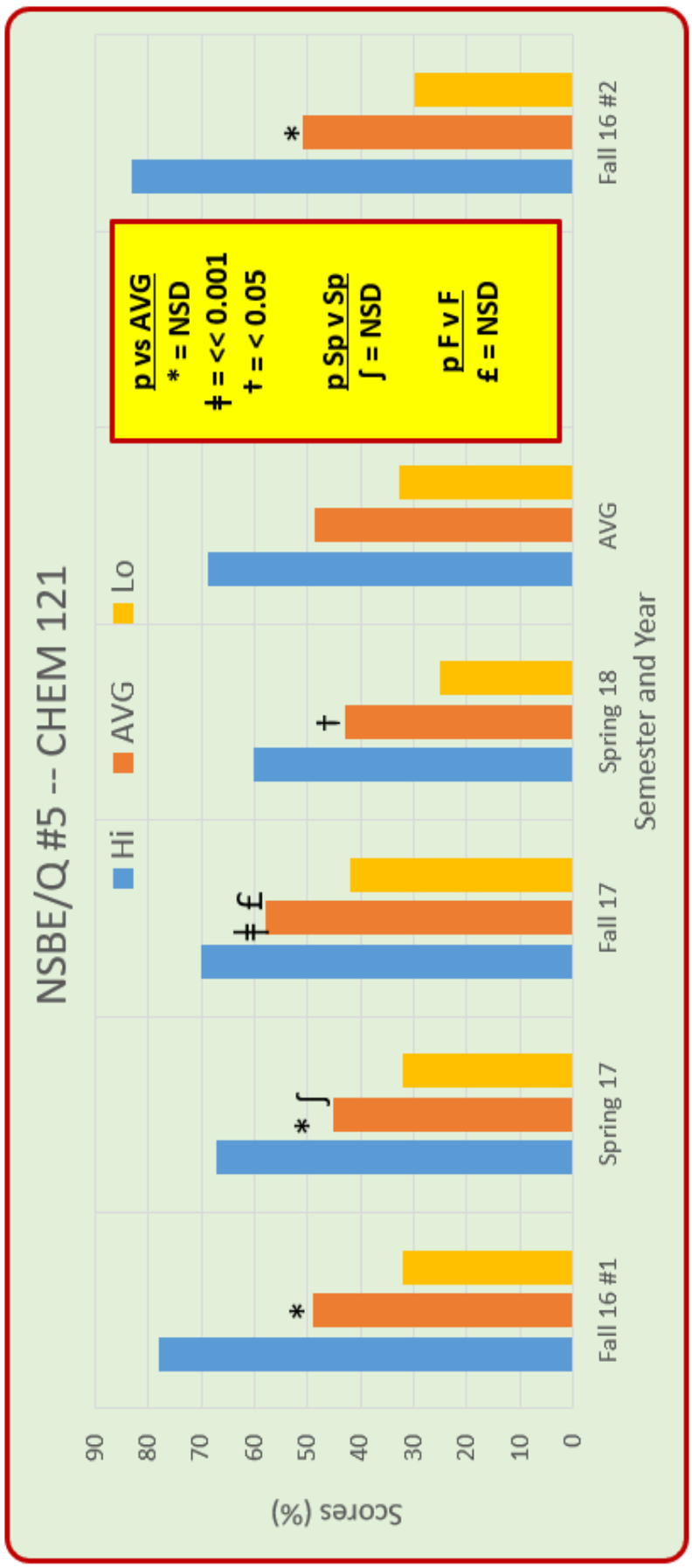


Figure 5. Results from Cross-Sectional Examination of Student Performance. NSBE/Q 5, CHEM 121.

Appendix 3: CHEM 121 Assessment

NSBE/Q 6 and 7, in toto

Cross-Sectional Population/Enrollment Results

Spring ‘17 – Spring ‘18

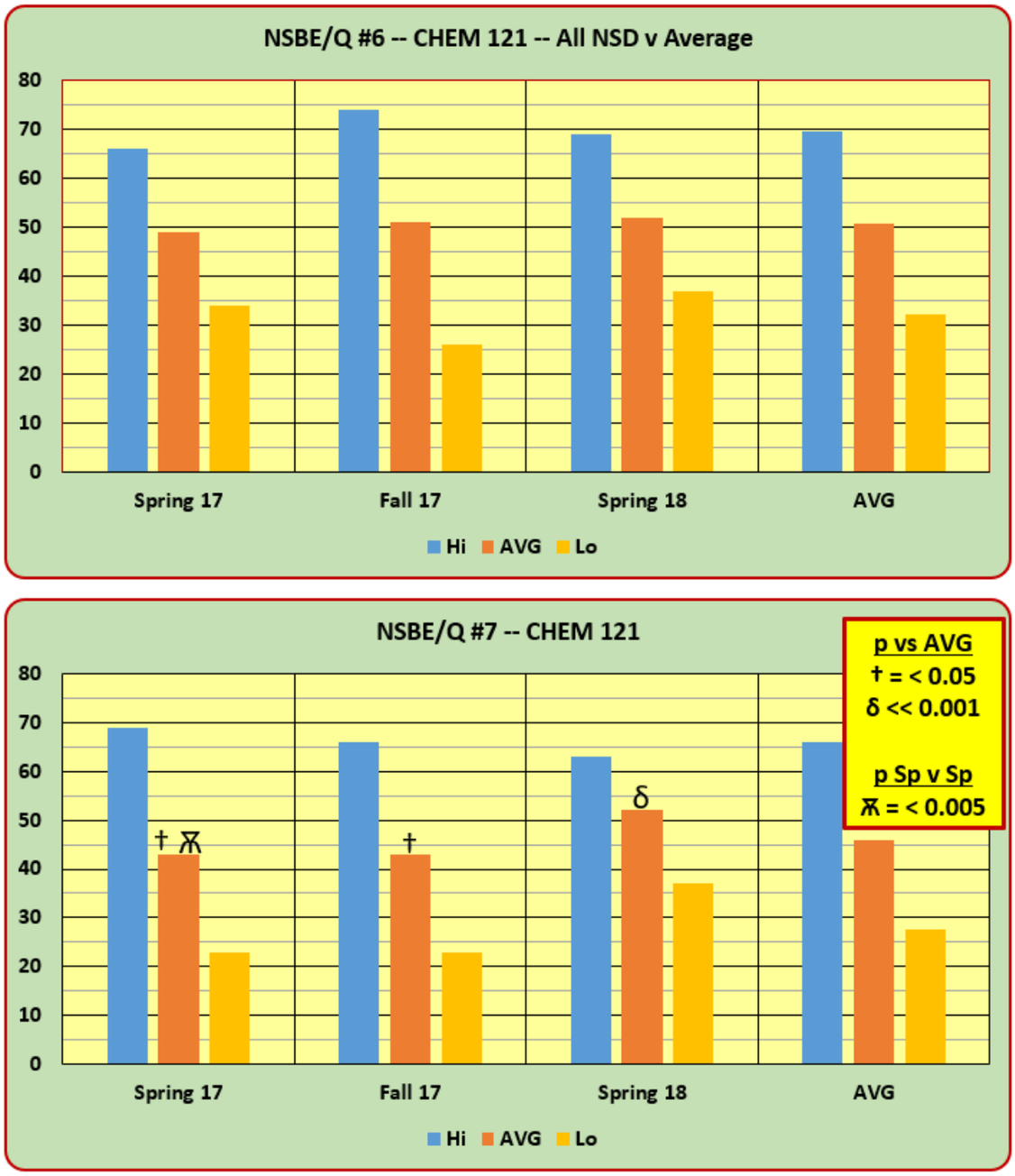


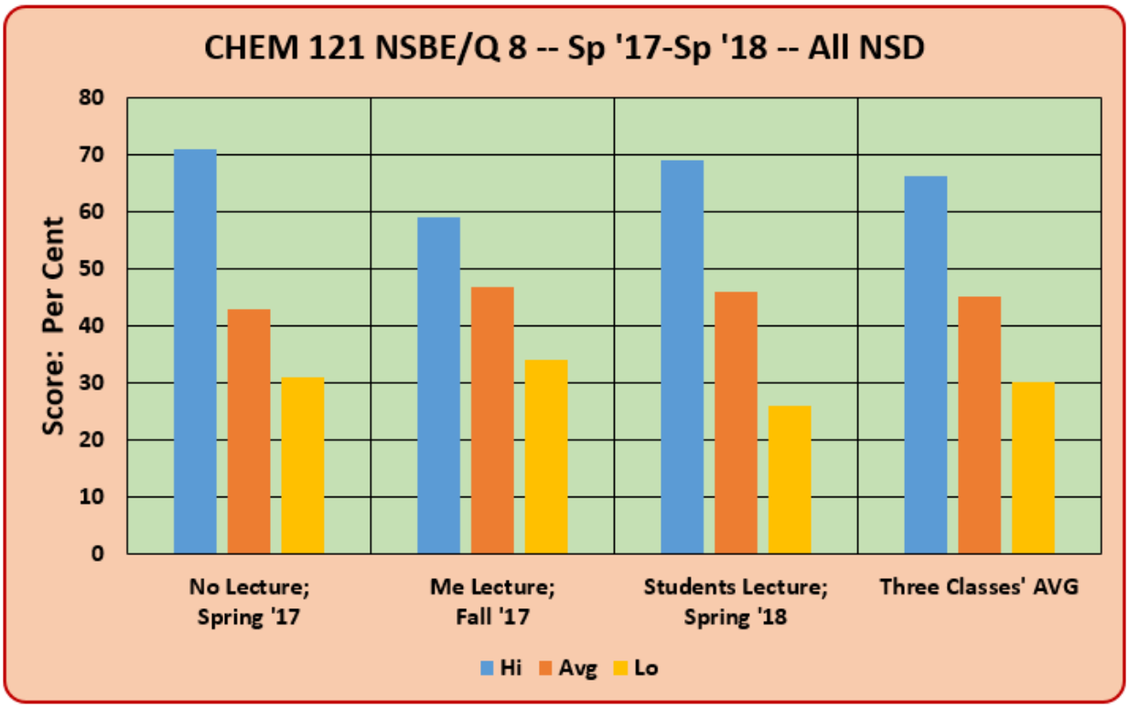
Figure 6. Results from Cross-Sectional Examination of Student Performance. NSBE/Q 6 and 7, CHEM 121. Vertical axes are percent correct responses.

Appendix 4: CHEM 121 Assessment

NSBE/Q 8, in toto

Cross-Sectional Population/Enrollment Results

Course Topics	All students will have a basic (first semester of a two semester laboratory based course) knowledge of the principles of Chemical Reactions, Stoichiometry, Atomic Structure, Chemical Bonding, Molecular Structure, States of Matter, Aqueous Solutions, Acid-Base Chemistry, Redox Reactions, Thermochemistry; and Have practiced the laboratory methods needed to observe and measure the above. **Inasmuch as CHEM 121 remains an alternative pre-requisite course to BIOL 223 and 251, sections on bio-organic chemistry and cell biochemistry are included in this course as bare bones' minimum preparation for these BIOL courses.**



Spring 2017, Fall 2017 and Spring 2018 Semesters

Figure 7. Results from Cross-Sectional Examination of Student Performance. NSBE/Q 8.

Appendix 5: CHEM 121 Assessment

Pre- and Post-Test Assessment, *in toto*

Cross-Sectional Population/Enrollment Results

Spring ‘17 – Spring ‘18

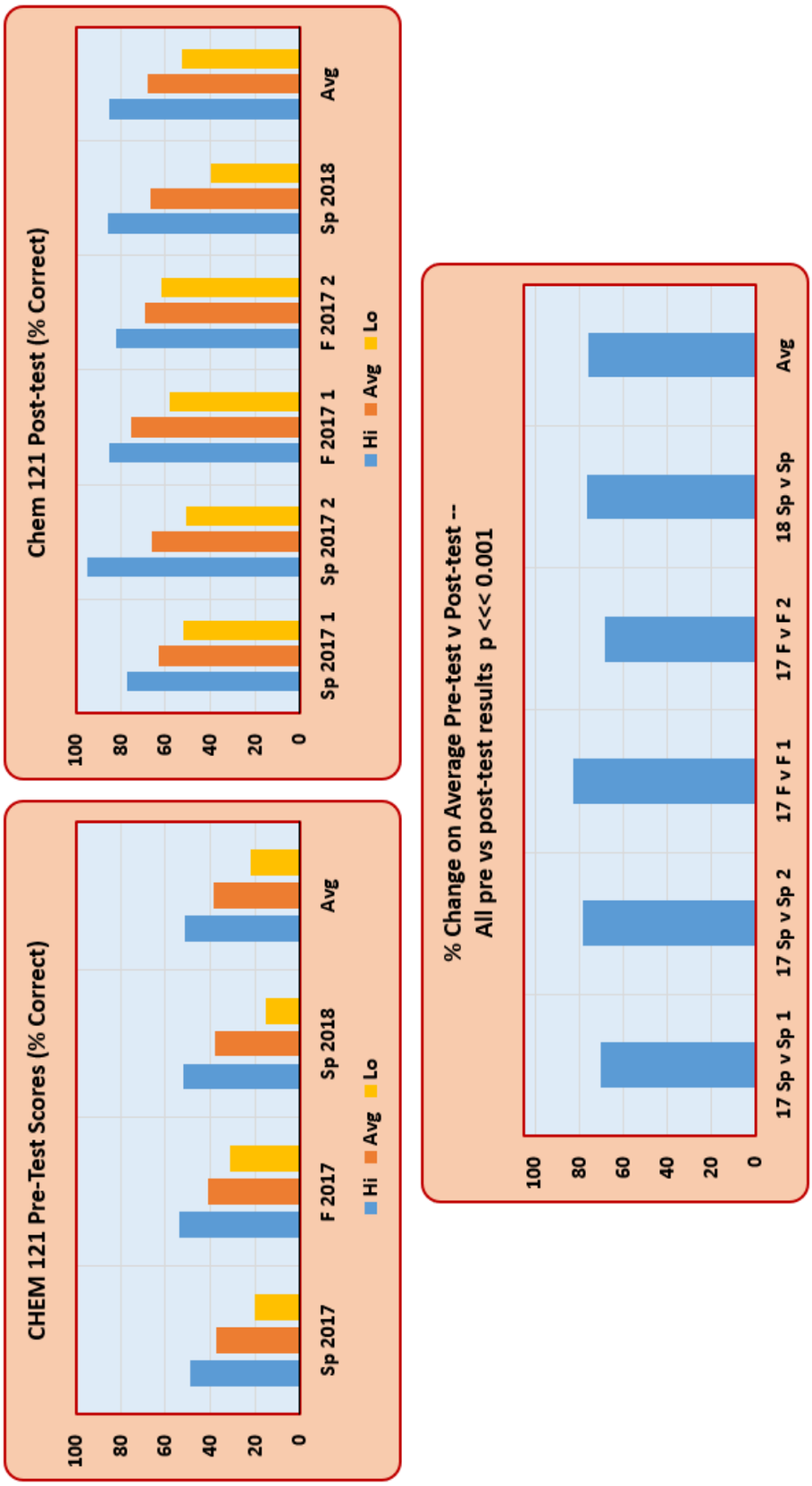


Figure 8. CHEM 121 Pre-Test v Post-Test Assessment Results. All score improvements are p <<< 0.001.

Appendix 6: CHEM 121 Assessment

Signature Assignment & Lab Theoretical Final

GESLO #1 and #4

Spring ‘17 – Spring ‘18

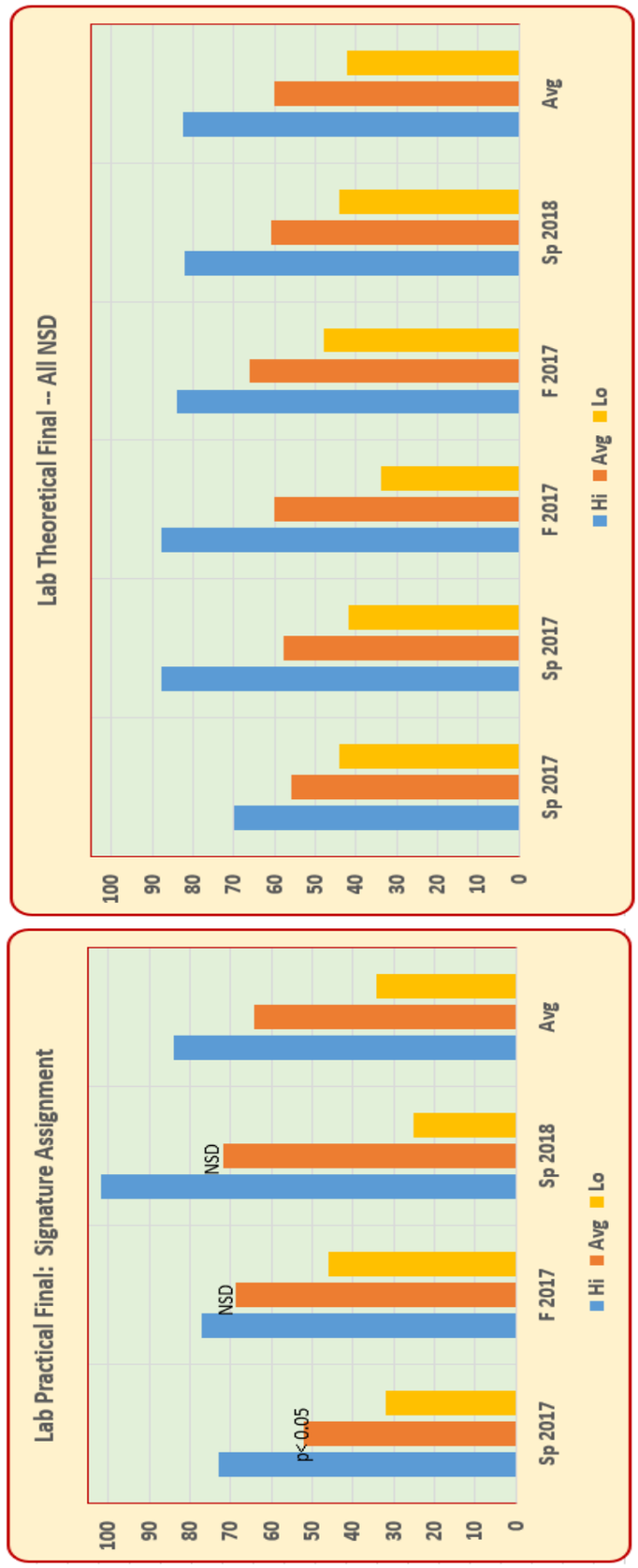


Figure 9. Bottom (left): Signature assignment; CHEM 121 Lab; Top (right): Lab Theory Final exam.

Appendix 7: CHEM 121 Assessment

CHEM 121 Final Course Grades: Cross-Sectional

Fall 2014-Spring 2018

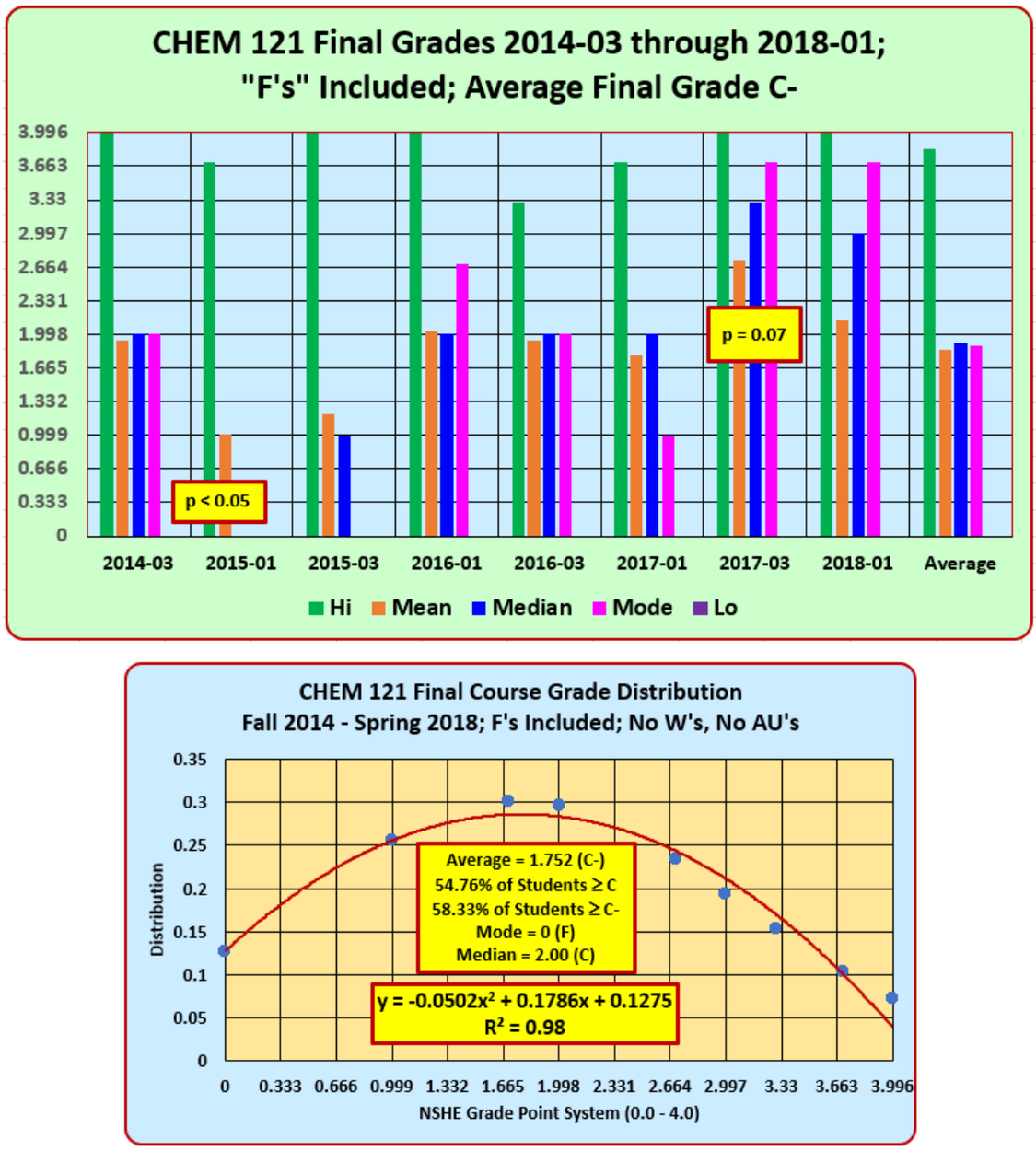


Figure 10. Top, CHEM 121 Final Course Grades; included Hi, Mean, Median, Mode and Lo (where there appears to be no lo, it was an F (0); Bottom, Bell distribution of grades over the same time period. Both images include "F's".

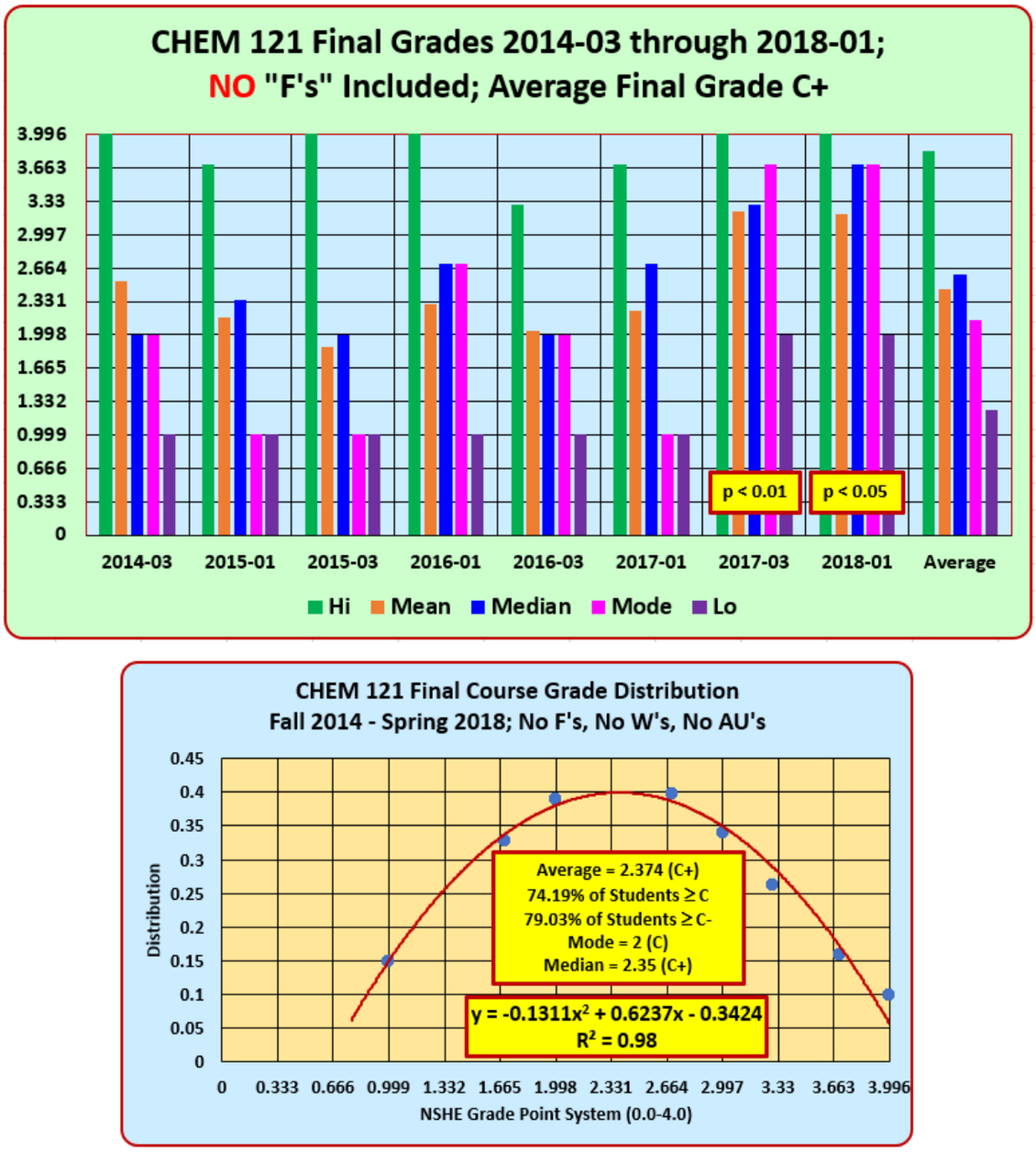


Figure 11. Top, CHEM 121 Final Course Grades; included Hi, Mean, Median, Mode and Lo; Bottom, Bell distribution of grades over the same time period. Both images do NOT include "F's".